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**Martin et al.**(10) **Patent No.:** **US 6,563,487 B2**  
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**Related U.S. Application Data**

- (63) Continuation-in-part of application No. 09/253,132, filed on Feb. 18, 1999, now Pat. No. 6,243,078, which is a continuation-in-part of application No. 09/156,802, filed on Sep. 17, 1998, now Pat. No. 6,184,868, which is a continuation-in-part of application No. 09/103,281, filed on Jun. 23, 1998, now Pat. No. 6,088,019.

(51) **Int. Cl.<sup>7</sup>** ..... **G09G 5/00**(52) **U.S. Cl.** ..... **345/156**(58) **Field of Search** ..... 345/156, 161,  
345/168, 169; 463/37, 38(56) **References Cited****U.S. PATENT DOCUMENTS**

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*Primary Examiner*—Richard Hjerpe*Assistant Examiner*—Ronald Laneau(74) *Attorney, Agent, or Firm*—Kilpatrick Stockton LLP(57) **ABSTRACT**

A haptic feedback control device coupled to a host computer and outputting forces to a user of the control device. The control device includes a housing, a direction pad capable of being contacted by the user in at least two different locations to provide two different directional signals to the host computer, and a computer-controlled actuator that outputs a force directly on the direction pad. A sensor, such as one or more contact switches, can detect when the locations of the direction pad have been contacted or pressed by the user. The actuator can be a linear or rotary actuator that outputs a force on the direction pad, e.g. approximately perpendicular to the top surface of the direction pad. The actuator can output a vibration or a pulse tactile sensation on the direction pad in coordination with interactions or events in a computer graphical environment or functions of a controlled electronic device. The control device can be a game controller, a mouse, a remote control device, or other type of device.

**60 Claims, 6 Drawing Sheets**